SUCCESSFUL EXPERIENCE WITH IN-SITU REGENERATION OF SCR CATALYST IN COAL FIRED APPLICATIONS

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SUMMARY

SCR catalyst deactivation in coal fired boilers (in particular, for high dust SCRs) should be taken into account and planned for in the power plant operating practice. The combined effect of plugging, masking and poisoning gradually reduces catalyst activity below design level. Typically this reduction is detected by an increased level of ammonia in the fly ash. Standard practice to compensate for this decline in activity is to add a new layer of catalyst (when space and extra fan capacity is available) or substitute the most deactivated layer of catalyst with a fresh one.

The costs associated with catalyst replacement are substantial and typically exceed 40% of SCR unit operating expenses. Using a catalyst rejuvenation technique ideally will result in significant savings. Different methods of reactivation developed thus far (acid wash, hot water bath, ultrasonic cleaning, abrasive cleaning, application of additional active material) have not received enthusiastic support from end users since they required removal of catalyst from the vessel and could not provide a proven record of successful full scale applications.

An attractive method of SCR catalyst regeneration has been developed by EnBW, the third largest power provider in Germany. Within their 15 years of SCR operating experience on both high- and low-dust applications, EnBW recognized the need for in-house catalyst testing and developed a state-of-the-art facility. During the first ten years the catalyst management strategy followed recommendations from the catalyst manufacturers - timely replacements of catalyst to avoid ammonia excursions, at an average cost in excess of $1 Million per year per boiler.

In 1995, EnBW engineers initiated work on a new method of catalyst rejuvenation having as its goal the substantial reduction of expenses associated with catalyst replacement. The criteria for the new method were:

- in-situ regeneration without removing catalyst
- no potential damages to the catalyst and the SCR box
- minimal man-hours to accomplish regeneration during short outages
- no exotic or dangerous chemicals should be required on plant site
- simple, safe and reliable equipment design and setup
- last, but not least, regeneration should be significantly less expensive than the cost of new catalyst

The new technology was developed, refined and extensively tested in the lab and successfully implemented in EnBW power plants.

This patented reactivation method (ReACT™) involves in-situ washing the catalyst with a safe and economic regenerating suspension, which is efficient in catalyst cleaning, dissolving masking materials and removing some poisonous species. The regeneration process involves four distinct steps:

- The typical process starts in the lab where the contaminated catalyst samples are tested for residual activity and surface conditions.

- During the second step the main parameters of the reactivation procedure are optimized in the lab to get maximum possible gain in catalyst activity. The parameters include intensity and duration of washing, composition of the regenerating suspension, and parameters of the re-circulation cycle.

- The third step is accomplished by in-situ washing of the layer of catalyst to be regenerated. The regenerating solution is sprayed over the catalyst elements, collected at the bottom of the layer and re-circulated. The equipment is simple, sectional and adaptable to any particular catalyst geometry. It is designed to prevent putting solution in contact with any power plant equipment as well as with downstream layers of catalyst. A team of 5 to 7 people can easily regenerate over 35 cubic feet of catalyst per hour. Complete regeneration of a full layer of catalyst on a 700 MW coal fired unit can be accomplished within a five day outage. The process can be run at ambient temperatures and therefore energy consumption, as well as potential for corrosion, are negligible.

- The fourth and final stage of the ReACT™ process is drying the catalyst after regeneration. This operation does not require more time than the routine heating for bringing an SCR reactor on-line.

The ReACT™ regeneration technique has been used for full scale SCR reactors since 1996 at several power plants with pulverized coal fired boilers, using a variety of coals, including U.S. coals. The regeneration procedure has proven to be successful for both plate type and honeycomb catalysts manufactured by different suppliers (MHI, Siemens, KWH, Haldor Topsoe, BASF).

The experience accumulated in 10 full scale regenerations (some of the layers repeatedly) permitted the refinement of the technique and improved in the accuracy of predicting the increase in catalytic activity. The achievable improvement differs for different mechanisms of catalyst degradation, depending on such factors as furnace type, ash composition, flue gas parameters, methods of SCR reactor operation. The increase in catalytic activity due to reactivation is typically higher for catalysts with substantial loss of initial activity. Measured results clearly demonstrate that in most cases a 20 to 30 absolute percent gain in activity can be achieved, even after repeat treatments. Monitoring catalyst activity before and after regeneration shows that the regeneration process does not change the pattern and rate of catalyst deactivation, it just brings the activity to the new higher lever.

It is worth mentioning that the SO_2 oxidation rate is not increased as the result of the reactivation procedure. The mechanical strength of the catalyst (both plate and honeycomb type) also is not affected by the regeneration.

The most important effect of the ReACT™ technology is the substantial increase in catalyst life, achieved at only a fraction of the cost of a new catalyst. Evaluation of relative cost per extra thousand hours of catalyst life demonstrates the benefits of using this technology for cost efficient catalyst management.